11-03-00

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PATENT
Docket No. OPLINK-2k11

Box Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

NEW APPLICATION TRANSMITTAL

Transmitted herewith for filing is the patent application of
Inventor(s): **Zhimin Liu**

WARNING: Patent must be applied for in the name(s) of all the actual inventor(s). 37 CFR 1.41(a) and 1.53(b).

For (title): **WAVELENGTH INTERLEAVER**

1. Type of Application

This new application is a(n) (check one applicable item below):

X Original
_ Design
_ Plant

WARNING: Do not use this transmittal for a completion in the U.S. of an International Application under 35 U.S.C. 371(c)(4) unless the International Application is being filed as a divisional, continuation or continuation-in part Application.

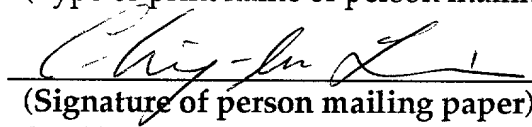
NOTE: If one of the following 3 items apply then complete and attach ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF A PRIOR U.S. APPLICATION CLAIMED.

_ Divisional
_ Continuation
_ Continuation-in-part (CIP)

CERTIFICATION UNDER 37 CFR 1.10

I hereby certify that this New Application Transmittal and the documents referred to as enclosed therein are being deposited with the United States Postal Service on this date **November 1, 2000** in an envelope as "Express Mail Post Office to Addressee" Mailing Label Number **EF088148074US** addressed to the : Commissioner of Patents and Trademarks, Washington, D.C. 20231.

Ching-lu Lin
(Type or print name of person mailing paper)



(Signature of person mailing paper)

NOTE: Each paper or fee referred to as enclosed herein has the number of the "Express Mail" mailing label placed thereon to mailing. 37 CFR 1.10(b).

2. Benefit of Prior U.S. Application(s) (35 USC 120)

NOTE: If the new application being transmitted is a divisional, continuation or a continuation-in-part of a parent case, or where the parent case is an International Application which designated the U.S., then check the following item and complete and attach ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

X The new application being transmitted claims the benefit of prior U.S. application(s) and enclosed are ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

3. Papers Enclosed Which Are Required For Filing Date Under 37 CFR 1.53(b) (Regular) or CFR 1.153 (Design) Application

9 Pages of specification
5 Pages of claims
1 Pages of Abstract
1 Pages of Drawings
X formal
__ informal

WARNING: DO NOT submit original drawings. A high quality copy of the drawings should be supplied when filing a patent application. The drawings that are submitted the Office must be on strong, white, smooth, and non-shiny paper and meet the standards according to 1.84. If corrections to the drawings are necessary, they should be made to the original drawing and a high-quality copy of the corrected original drawing then submitted the Office. **Only one copy is required or desired.** Comments on proposed new 37 CFR 1.84. Notice of March 9, 1988 (1990 O.G. 57-62).

NOTE: "Identify indicia such as the serial number, group and unit, title of the invention, attorney's docket number, inventor's name, number of sheets, etc., not to exceed 2 3/4 inches (7.0 cm.) in which may be placed in a centered location between the side edges within three fourths inch (19.1 mm.) of the top edge. Either this marking technique on the front of the drawing is acceptable." Proposed 37 CFR 1.84 (1). Notice of March 9, 1988 (1090 O.G. 57-62)

4. Additional papers enclosed

_ Preliminary amendment
_ Information Disclosure Statement
_ Form PTO-1449
_ Citations
_ Declaration of Biological Deposit
_ Submission of "Sequence Listing," computer readable copy and/or amendment pertaining thereto for biotechnology invention containing nucleotide and/or amino acid sequence.
_ Authorization of Attorney(s) to Accept and Follow Instructions from Representative
_ Special Comments
_ Other

5. Declaration or oath

X Enclosed

executed by (*check **all** applicable boxes*)

X inventor(s).

_ legal representative of inventor(s) . 37 CFR 1.42 or 1.43

_ joint inventor or person showing a proprietary interest on behalf of inventor who refused to sign or cannot be reached

_ this is the petition required by 37 CFR 1.47 and the statement required by 37 CFR 1.47 is also attached. *See item 13 below for fee.*

_ Not Enclosed.

WARNING: Where the filing is a completion in the U.S. of an International Application but where a declaration is not available or where the completion of the U.S. application contains subject matter in addition to the International Application the application may be treated as a continuation or continuation-in-part as the case may be, utilizing ADDED PAGE FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION CLAIMED.

_ Application is made by a person authorized under 37 CFR 1.41 (c) on behalf of *all* the above named inventor(s). The declaration or oath, along with the surcharge required by 37 CFR 1.16 (e) can be filed subsequently.

NOTE: It is important that **all** the correct inventor(s) are named for filing under 37 CFR 1.41 (c) and 1.53 (b).

6. Inventorship Statement

WARNING: If the named inventors are each not the inventors of all the claims an explanation, including the ownership of the various claims at the time the **last** claimed invention was made, should be submitted.

The inventorship for all the claims in this application are:

X The same

or

_ Are not the same. An explanation, including the ownership of the various claims at the time the **last** claimed invention was made.

_ is submitted

_ will be submitted.

7. Language

NOTE: An application including a signed oath or declaration may be filed in a language other than English. A verified English translation of the non-English language application and the processing fee of $30.00 required by 37 CFR 1.17(k) is required to be filed with the application or within such time as may be set by the Office. 37 CFR 1.5(d).

NOTE: A non-English oath or declaration in the form provided or approved by the PTO need not be translated. 37 CFR 1.69(b).

X English

_ non-English

_ the attached translation is a verified translation. 37 CFR 1.52(d).

8. **Assignment**

X An assignment of the invention to Oplink Communications, Inc.
X is attached
_ will follow

NOTE: "If an assignment is submitted with a new application, send two separate letters-one for the application and one for the assignment" Notice of May 4, 1990.

9. Certified Copy

Certified cop(ies) of application(s)

(country) (appl.no.) (filed)

from which priority is claimed

_ is (are) attached . A separate "ASSIGNMENT COVER LETTER ACCOMPANYING NEW PATENT APPLICATION" is also attached
_ will follow.

NOTE: The foreign application forming the basis for the claim for priority must be referred to in the oath or declaration. 37CFR 1.55(a) and 1.63.

NOTE: This item is for any foreign priority for which the application being filed directly relates. If any parent U.S. application or International Application from which this application claims benefit under 35USC120 is itself entitled to priority from a prior foreign application then complete item 18 on the ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

10 Fee Calculation (37 CFR 1.16)

A X Regular application

CLAIMS AS FILED				
Number filed	Number Extra		Rate	Basic Fee $710.00
Total Claims 37 CFR 1.16(c)	21-20 = 1	x	$18.00	18.00
Independent Claims (37CFR 1.16(b))	3 -3 = 0	x	$80.00	0.00
Multiple dependent claim(s), if any (37 CFR 1.16(d))			$270.00	0.00

_ Amendment Cancelling extra claims enclosed.
_ Amendment deleting multiple-dependencies enclosed.
_ Fee for extra claims is not being paid at this time.

note: If the fees for extra claims are not paid on filing they must be paid or the claims cancelled by amendment, prior to the expiration of the time period set for response by the Patent and Trademark Office in any notice of fee deficiency. 37CFR1.16(d).

Filing fee calculation $ 728.00

B. _ **Design application**
($310.00 - 37 CFR 1.16(f))

Filing fee calculation $_____

C _ **Plant application**
($510.00 - 37 CFR 1.16(g))

Filing fee calculation $_____

11. Small Entity Statement(s)

__ Verified Statement(s) that his is a filing by a small entity under 37 CFR 1.9 and 1.27 is (are) attached.

Filing Fee Calculation (50% of **A, B,** or **C** above) $_____

NOTE: any excess of the full fee paid will be refunded if a verified statement and a refund request are filed within 2 months of the date of timely payment of a full fee. 37 CFR 1.28(a).

12. Request for International-Type Search (37 CFR 1.104(d)) (*complete, if applicable*)

_ Please prepare an international-type search report for this application at the time when national examination on the merits takes place.

13. Fee Payment Being Made At This Time

_ Not Enclosed

_ No filing fee is to paid at this time. (*This and the surcharge required by 37 CFR 1.16(e) can be paid subsequently.*)

X Enclosed

X basic filing fee $_____ 728.00

X recording assignment
($40.00; 37 CFR 1.21(h)) $_____ 40.00

_petition fee for filing by other than all the inventors or person on behalf of the inventor where inventor refused to sign or cannot be reached.
($120.00; 37 CFR 1.47 and 1.17(h)) $_____

_ for processing an application with a specification in a non-English language. ($300.00; 37 CFR 1.52(d) and 1.17(k)) $_____

_ processing and retention fee
($130.00; 37 CFR 1.53(d) and 1.21(l))

_ fee for international-type search report
($40.00; 37 CFR 1.21(e)) $_____

NOTE: 37 CFR 1.21(l) establishes a fee for processing and retaining any application which is abandoned for failing to complete the application pursuant to 37 CFR 1.53(d) and this, as well as the changes to 37 CFR 1.53 and 1.78, indicate that in order to obtain the benefit of a prior U.S. application, either the basic filing fee must be paid or the processing and retention fee of 1.21(l) must be paid within 1 year from notification under 53(d).

Total fees enclosed $ _____ 768.00

14. Method of Payment of Fees

X Check in the amount of $ 768.00

_ Charge Account No. in the amount of $_____. A duplicate of this transmittal is attached.

NOTE: Fees should be itemized in such a manner the it is clear for which purpose the fees are paid. 37 CFR 1.22(b).

15. Authorization to Charge Additional Fees

WARNING: if no fees are to be paid on filing the following items should **not** be completed.

WARNING: Accurately count claims, especially multiple dependent claims, to avoid unexpected high charges, if extra claim charges are authorized.

X The Commissioner is hereby authorized to charge the following additional fees by this paper and during the entire pendency of this application to Account No. 12-0005.

X 37 CFR 1.16(a), (f) or (g) (filing fees)

X 37 CFR 1.16(b), (c) and (d) (presentation of extra claims)

NOTE: Because additional fees for excess or multiple dependent claims not paid on filing or on later presentation must only be paid or these claims cancelled by amendment prior to the expiration of the time period set for response by the PTO in any notice of fee deficiency (37 CFR 1.16(d)) it might be best not to authorize the PTO to charge additional claim fees, except possibly when dealing with amendments after final action.

_ 37 CFR 1.16(e) (surcharge for filing the basic filing fee and/or declaration on a date later then the filing date of the application)

_ 37 CFR 1.17 (application processing fees)

WARNING: While 37 CFR 1.17(a),(b) (c) and (d) deal with extensions of time under 1.136(a) this authorization should be made only with the knowledge that: "Submission of the appropriate extension fee under 37 C.F.R. 1.136(a) is to avail unless a request or petition for extension is filed." (Emphasis added). Notice of November 5, 1985 (1060 O.G. 27)

_ 37 CFR 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 CFR 1.311(b))

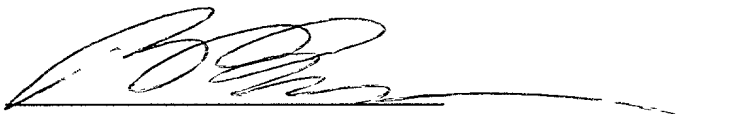
NOTE: Where an authorization to charge the issue fee to a deposit account has been filed before the mailing of a Notice of Allowance, the issue fee will be automatically charged to the deposit account at the time of mailing the notice of allowance. 37 CFR 1.311(b).

NOTE: 37 CFR 1.28(b) requires "Notification of any change in loss of entitlement to small entity status must be filed in the application...prior to paying, issue fee". From the wording of 37 CFR 1.28(b): (a) notification of change of status must be made even if the fee is paid as "other than a small entity" and (b) no notification is required if the change is to another small entity.

16. Instructions As to Overpayment

_ credit Account No.

X refund



Reg. No.**33,948** **SIGNATURE OF ATTORNEY**

Bo-In Lin

Tel. No. (415) 949-0418 Type or print name of attorney

P.O. Address : **13445 Mandoli Drive,**
Los Altos Hills, CA 94022

_X_ Incorporation by reference of added pages

Check the following item if the application in this transmittal claims the benefit of prior U.S. application(s) (including an international application entering the U.S. stage as a continuation, divisional or C-I-P application) and complete and attach the ADDED PAGES FOR A NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED

X Plus Added Pages For New Application Transmittal Where Benefit Of Prior U.S. Application(s) Claimed

Number of pages added ____One____

_ Plus Added Pages For Papers Referred To In Item 4 Above

Number of pages added ________

_ Plus "Assignment Cover Letter Accompanying New Application"

Number of pages added ________

__ Statement Where No Further Pages Added

(If no further pages form a part of this Transmittal then end this Transmittal with this page and check the following item)

__ This transmittal ends with this page

WAVELENGTH INTERLEAVER

This Formal Application claims a Priority Date of November 1, 1999 benefited from a Provisional Application 60/162,751, filed by the same Applicant of this Application on November 1, 1999.

FIELD OF THE INVENTION

The present invention relates generally to a signal transmission system implemented with optical fibers and related optical components. More particularly, this invention relates to an optical interleave device implemented in a dense wavelength division multiplexing (DWDM) system.

BACKGROUND OF THE INVENTION

As the optical wavelength division multiplexing (WDM) technology gradually becomes the standard backbone network for the fiber optic communication systems, a challenge is continuously faced by those of ordinary skill in the art to increase the transmission capacity due to the bandwidth limitations of the optical fiber signal transmission systems. Specifically, the bandwidth of the optical fiber amplifier, such as Erbium doped fiber amplifier (EDFA), is limited as more and more channels are inserted into the transmission band. The wavelength spacing between adjacent channels employed for carrying the optical signals becomes narrower when more channels are "squeezed in" the transmission band for the purpose of satisfying a requirement of increasing the transmitting capacity of the signal transmission system. However, the wavelength division multiplexing (WDM) technologies employing dielectric filters are confronted with a limitation due to the ability to separate one channel from adjacent ones when the channel spacing is further reduced with increased number of channels. Another technical approach applies a fiber grating technology for multiplexing and de-multiplexing the optical signals transmitted over optical fiber systems. However, the fiber grating technology is limited by the temperature sensitivity problems when the channel spacing becomes narrower.

As the fiber optical industry is now providing stable products for 200 GHz and 100 GHz channel spacing WDM signal transmission over the optical fiber systems, a new interleave technology emerges in attempt to further reduce the channel spacing to achieve higher bandwidth. An interleaver is an optical device employed to select wavelength channel according to predefined channel spacing. As an example, when optical signals of N channels with 50 GHz channel spacing are transmitted to an optical interleaver, the optical interleaver separates the optical signals into a first group of signals consisted of channels 1, 3, 5, ...N-1, and a second group of signals consisted of channels of 2, 4, 6,..N, with channel spacing of 100GHz. Therefore, fiber optical system implemented with an optical interleaver is capable to process optical signals transmitted with a narrow channel spacing by first separating the signals into groups of signals with broader channel spacing such that optical devices currently provided by the optical fiber industry can be applied to further process these optical signals outputted from the interleaver.

As the WDM technology now enables the utilization of substantially wider fiber bandwidth for signal transmission, a number of prior art patents disclosed methods and configurations deal with interleaver. The interleaver according to the state of the art are bulky, and having a high production cost due to the need of using more expensive materials and optical elements.

Therefore, a need still exists in the art of manufacturing and designing the fiber optic interleaver to provide simpler configurations that would reduce size and production cost.

SUMMARY OF THE PRESENT INVENTION

It is therefore an object of the present invention to provide a new design and configuration for manufacturing and assembling a fiber optic interleaver with reduced size to provide compact interleaver with lower the production.

Specifically, it is an object of the present invention to provide an interleaver implemented with new configuration by employing a phase delay generating means such as a glass plate to construct a type of March-Zanter interferometer to induce an optical interference for enhancing signal transmission at certain wavelengths. The phase delay generating means such as a glass plate are positioned between a pair of collimator lenses for inducing interference between two portions of collimated beam transmitted with different phases. Lights with certain wavelength are transmitted and lights with other wavelengths are compressed. Therefore, the phase delay generating means can be implemented to selectively enhance and suppress signal transmission with predefined wavelengths thus achieve the function as an interleaver.

Briefly, in a preferred embodiment, the present invention includes an optical interleaver that includes a first collimator lens for collimating an input optical signal into collimated beams and a second collimator lens for focusing the collimated beam into an output optical fiber. The interleaver further includes a phase delay generating means for generating a phase-delay between portions of the collimated beam for generating interference in the second collimator lens for selectively enhance signal transmission of certain wavelengths. In a preferred embodiment, the phase delay generating means comprising a glass plate blocking a portion of the collimated beam for generating a phase delay for a portion of the collimated beam passing through. In another preferred embodiment, the phase delay generating means comprising a glass plate having an upper portion covering an upper portion of the collimated beam. The glass plate having a lower portion covering a lower portion of the collimated beam for generating a phase delay between the upper portion and lower portion of the collimated beam. In another preferred embodiment, the interleaver further includes a control means for controlling the phase delay generating means for selectively generating signal transmission at different wavelengths according to the interference generated in the second collimator lens. In yet another preferred embodiment, the phase delay generating means comprising a glass plate having a plurality of predefined segments. Each segment has different combination of plate-

thickness and diffraction index wherein the phase delay generating means is controlled by the control means for selectively generating signal transmission at different wavelengths with a predefined program. In another preferred embodiment, the phase delay generating means comprising a set of cascaded interferometer for making top flat profile of the transmissions band. In another preferred embodiment, each of the a set of cascaded interferometer comprising a phase delay plate and a half-pitch GRIN lens. In another preferred embodiment, each of the a set of cascaded interferometer comprising a phase delay plate and a pair of focus and collimating lenses. In another preferred embodiment, the interleaver further includes a reflective means for reflecting a portion of the collimated beam as second beam transmitted along a second optical path away from the collimated beam. The interleaver further includes a third collimator lens for focusing the second group of beam into a second output optical fiber. And, the interleaver further includes a second phase delay generating means for generating a second phase-delay between portions of the second beam. Thus an interference in the third collimator lens is generated for selectively enhance signal transmission of a second set of wavelengths outputting from the second optical fiber.

In summary, this invention discloses an optical interleaver that includes a phase delay generating means for generating a phase delay between different portions of optical beam for selectively enhancing signal transmissions at certain wavelengths resulting from interference between the different portions of optical beam. In a preferred embodiment, the interleaver further includes a control means for controlling the phase delay generating means controlling a selection of certain wavelengths for enhanced signal transmission. In another preferred embodiment, the phase delay generating means further comprising an optical element for transmitting optical beam through. In another preferred embodiment, the phase difference generating means further comprising the optical element for transmitting optical beam through with at least two portions of different thickness. In another preferred embodiment, the phase delay generating means further comprising the optical element for transmitting

optical beams through with at least two portions of different diffraction indexes.

These and other objects and advantages of the present invention will no doubt become obvious to those of ordinary skill in the art after having read the following detailed description of the preferred embodiment, which is illustrated in the various drawing figures.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1A is a cross sectional view of a collimator with a glass plate blocks one portion of the collimated beam to provide a phase delay according to this invention;

Fig. 1B is a cross sectional view of a collimator with a combined glass plate to provide a phase delay;

Fig. 2 is a cross sectional view for showing a configuration of a multiple step interleaver;

Fig. 3 is a cross sectional view of interleaver of this invention with two output fibers.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Fig. 1 for a cross sectional view of an interleaver 100 manufactured with a new configuration of this invention. The interleaver 100 includes a first collimator lens 110 to receive input optical signals transmitted from an input optical fiber 105. The first collimator lens 110 collimates the input optical signals into collimated light beam 115. The beam projects to a second collimator lens 120. The second collimator lens 120 then focuses the light beam onto an output optical fiber 125. The interleaver 100 further includes a glass plate 130 blocks a lower half portion of the beam 115. The glass plate provides a special optical

characteristic to add a phase delay for the portion of the beam 115 passing through the plate. Therefore, as a result of passing through the glass plate 130, the portion of the beam 115 that passes through the glass plate 130 are transmitted to the second collimator lens 120 with a phase delay. An optical interference occurs between the lower portion with a phase delay and the higher portion of the beams 115 without a phase delay. As a result of the interference, the lights having a wavelength satisfying a condition of:

$$(n-1)\, t = m\lambda \qquad (1)$$

are enhanced. The symbol λ represents the wavelength, m represents a positive integer, t is the thickness of the glass plate 130 and n is the diffraction index of the glass plate 130. As a result of the interference between these two portions of beams in the collimator lens 120, the lights with wavelength that do not satisfy the condition of Equation (1) are suppressed. By carefully controlling the thickness t of the glass plate, the interleaver 100 can be applied to select a series of wavelengths with selected wavelength spacing for a WDM signal transmission system. For instance, by making the glass plate as a circular plate and having different thickness along different radial angles, the circular glass plate 130 can be rotated. Different portions of the circular plate 130 are controlled to rotate for blocking the portion of beam 115 thus generating optical signals of different wavelengths according to the condition of Equation (1) with specific thickness t.

Fig. 1B is an alternate preferred embodiment of Fig. 1A with a glass plate 140 to cover the entire optical path thus covering the upper and lower portions of the beam 115. The glass plate 140 has an upper portion 140-U and a lower portion 140-L, with these two portions with two different thicknesses or two different diffraction indexes. Thus a phase difference is generated between the beams after passing through the glass plate. Again, interference occurs between these two portions of beams and wavelength that satisfies the condition of Equation (1) is enhanced, otherwise, the optical transmission is suppressed. The glass plate 140 can

be employed for controlling and selecting different wavelength for signal transmission by controlling the thickness and material index.

Referring to Fig. 2 for another preferred embodiment of an interleaver 200 of this invention. The interleaver 200 includes a first collimator lens 210 to receive input optical signals transmitted from an input optical fiber 205. The first collimator lens 210 collimates the input optical signals into collimated beam 215. The light beam projects to a second collimator lens 220. The second collimator lens 220 then focuses the light beam onto an output optical fiber 225. The interleaver 200 further includes cascaded interferometers interposed between the first collimator lens 210 and the second collimator lens 220. The interferometer includes a phase delay glass plate 230 and 250 followed by half pitch GRIN lens 240 and 260 for focusing a collimated beam inside the GRIN lens and then re-collimates the beam again into collimated beam. The phase delay plate 230 divide the beam into two portions with a phase difference between these two portions of beam. With the phase difference, these two groups of beams interfere with each other in passing through the half pitch GRIN lenses 240 and re-collimated by lens 240 again. Plate 250 divides the beam into two equal or different portions again and provide phase delay for the portion, the two portions of light interference in DRIN lens 260 again. The interference beam gets re-collimated by GRIN lens 260 again and received by collimator 220. The second phase delay provided by the plate 250 is different from the phase delay provided by plate 230 to make top flat profile of transmitting band. Several interferometer can be cascaded as shown to provide top-flat wavelength pass band interleaver 200 as often required in a wavelength division multiplexing (WDM) system. Instead of the half-pitch GRIN lenses 240 and 260, a pair of focus/collimate convention lenses can be used to replace the GRIN lenses 240 and 260 as that shown in Fig. 2.

Referring to Fig. 3 for another preferred embodiment of an interleaver 300 of this invention. The interleaver 300 includes a first collimator lens 310 to receive input optical signals transmitted from an input optical fiber 305. The first collimator lens 310 collimates the input

optical signals into collimated light beam 315. The light beam project to a second collimator lens 320. The second collimator lens 320 then focuses the light beam onto an output optical fiber 325. The interleaver 300 further includes a phase delay glass plate 330 to generate a phase delay difference between two portions of the beam 315. Therefore, as a result of passing through the glass plate 330, two portion of parallel beams with phase delay difference are projected to the second collimator lens 320 to interfere with each other. Optical signals with specific wavelengths satisfying Equation (1) are enhanced and transmitted from the first optical fiber 325.

The first phase delay glass plate 330 further includes a partially reflective front surface for reflecting a portion of the collimated beam 315 to a mirror 340 disposed away from the optical path of the beam 315. The mirror 340 reflects the beam 335 to a second collimator lens 350 for transmitting a output signal from a second output optical fiber 360. A second phase delay glass plate 345 is placed between the mirror 340 and the second collimating lens 350 to add a phase delay difference between different portion of the beam 335. As discussed above, the portions of beams that have a phase difference will again interfere with each other according to Equation (1) to generated optical signals with wavelengths that are enhanced or suppressed. Optical signals with selected wavelengths are then selected by using particular designed phase delay phase plates 330 and 345. The first and second phase delay glass plates 330 and 340 can be arranged to select a group of wavelength represented by $\lambda 1, \lambda 3, \lambda 5, .., \lambda n-1$, and $\lambda 2, \lambda 4, \lambda 6, .., \lambda n$ respectively for an incoming WDM optical signals represented by $\lambda 1, \lambda 2, \lambda 3, \lambda 4.., \lambda n-1, \lambda n$. Alternatively, a 1X2 optical coupler can be placed before the device to provide such separation as well.

Although the present invention has been described in terms of the presently preferred embodiment, it is to be understood that such disclosure is not to be interpreted as limiting. Various alternations and modifications will no doubt become apparent to those skilled in the art after reading the above disclosure. Accordingly, it is intended that the appended claims be interpreted as covering all alternations and modifications as fall within the true spirit and scope of the invention.

CLAIMS

I claim:

1. An optical interleaver comprising:

a first collimating lens for collimating an input optical signal into collimated beams and a second collimating lens for focusing said collimated parallel beams into an output optical fiber; and

a phase delay difference generating means for generating a phase-delay difference between portions of said collimated parallel beams for generating an interference in said second collimating lens for selectively enhance signal transmission of certain wavelengths.

2 The optical interleaver of claim 1 wherein:

said phase delay difference generating means comprising a glass plate blocking a portion of said collimated parallel beams for generating a phase delay for a portion of said collimated parallel beams passing therethrough.

3 The optical interleaver of claim 1 wherein:

said phase delay difference generating means comprising a glass plate having an upper portion covering an upper portion of said collimated parallel beams and said glass plate having a lower portion covering a lower portion of said collimated parallel beams for generating a phase delay difference between said upper portion and lower portion of said collimated parallel beams.

4 The optical interleaver of claim 1 further comprising:

a control means for controlling said phase delay difference generating means for selectively generating signal transmission at different wavelengths according to said interference generated in said second collimating lens.

5 The optical interleaver of claim 4 further comprising:

said phase delay difference generating means comprising a glass plate having a plurality predefined segments with different combination of plate-thickness and diffraction index wherein said phase delay difference generating means is controlled by said control means for selectively generating signal transmission at different wavelengths with a predefined program.

6 The optical interleaver of claim 1 wherein:

said phase delay difference generating means comprising a set of cascaded March-Zanter interferometer for generating a series of band-pass signal transmissions.

7 The optical interleaver of claim 6 wherein:

each of said a set of cascaded March-Zanter interferometer comprising a phase delay plate and a half-pitch GRIN lens.

8 The optical interleaver of claim 6 wherein:

each of said a set of cascaded March-Zanter interferometer comprising a phase delay plate and a pair of focus and collimating lenses.

9. The optical interleaver of claim 1 further comprising:

a reflective means for reflecting a portion of said collimated beams as second group of parallel beams transmitted along a second optical path away from said collimated parallel beams;

a third collimating lens for focusing said second group of parallel beams into a second output optical fiber; and

a second phase delay difference generating means for generating a second phase-delay difference between portions of said second group of parallel beams for generating an interference in said third collimating lens for selectively enhance signal transmission of a second set of wavelengths outputting from said second optical fiber.

10 The optical interleaver of claim 9 wherein:

said reflective means comprising a partially reflective front surface of said phase delay means and a mirror for reflecting a portion of said collimated beams as second group of parallel beams transmitted along a second optical path away from said collimated parallel beams.

11 An optical interleaver comprising:

a phase difference generating means for generating a phase difference between different portion of optical beams for selectively enhancing signal transmissions at certain wavelengths resulting from interference between said different portions of optical beams.

12 The optical interleaver of claim 11 further comprising:

a control means for controlling said phase difference generating means controlling a selection of certain wavelengths for enhanced signal transmission.

13 The optical interleaver of claim 11 wherein:

said phase difference generating means further comprising an optical element for transmitting optical beams therethrough.

14 The optical interleaver of claim 13 wherein:

said phase difference generating means further comprising said optical element for transmitting optical beams therethrough with at least two portions of different thicknesses.

15 The optical interleaver of claim 13 wherein:

said phase difference generating means further comprising said optical element for transmitting optical beams therethrough with at least two portions of different diffraction indexes.

17 A method for configuring an optical interleaver comprising:

employing a phase difference generating means for generating a phase difference between different portion of optical beams for selectively enhancing signal transmissions at certain wavelengths resulting from interference between said different portions of optical beams.

18 The method of claim 17 further comprising:

employing a control means for controlling said phase difference generating means controlling a selection of certain wavelengths for enhanced signal transmission.

19 The method of claim 17 wherein:

said step of employing said phase difference generating means further comprising a step of employing an optical element for transmitting optical beams therethrough.

20 The optical interleaver of claim 19 wherein:

said step of employing said optical element for transmitting said optical beams therethrough is a step of employing said optical element with at least two portions of different thicknesses for transmitting said beams through.

21 The optical interleaver of claim 19 wherein:

said step of employing said optical element for transmitting said optical beams therethrough is a step of employing said optical element with at least two portions of different diffraction indexes for transmitting said beams through.

ABSTRACT

This invention discloses an optical interleaver that includes a first collimating lens for collimating an input optical signal into collimated beams and a second collimating lens for focusing the collimated parallel beams into an output optical fiber. The interleaver further includes a phase delay difference generating means for generating a phase-delay difference between portions of the collimated parallel beams for generating an interference in the second collimating lens for selectively enhance signal transmission of certain wavelengths. In a preferred embodiment, the phase delay difference generating means comprising a glass plate blocking a portion of the collimated parallel beams for generating a phase delay for a portion of the collimated parallel beams passing therethrough. In another preferred embodiment, the phase delay difference generating means comprising a glass plate having an upper portion covering an upper portion of the collimated parallel beams. The glass plate having a lower portion covering a lower portion of the collimated parallel beams for generating a phase delay difference between the upper portion and lower portion of the collimated parallel beams. In another preferred embodiment, the interleaver further includes a control means for controlling the phase delay difference generating means for selectively generating signal transmission at different wavelengths according to the interference generated in the second collimating lens.

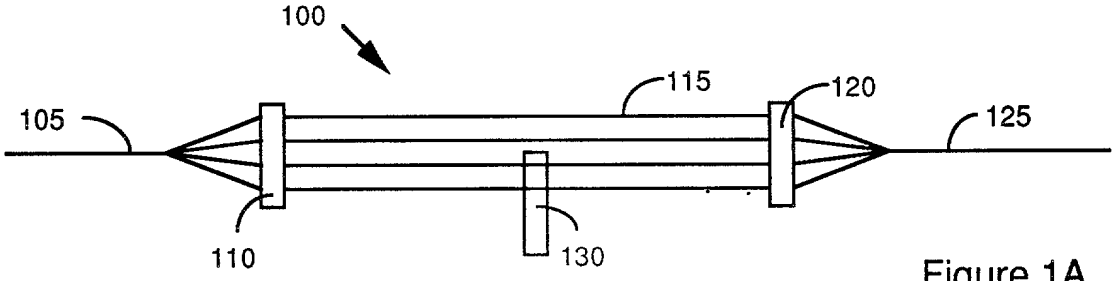


Figure 1A

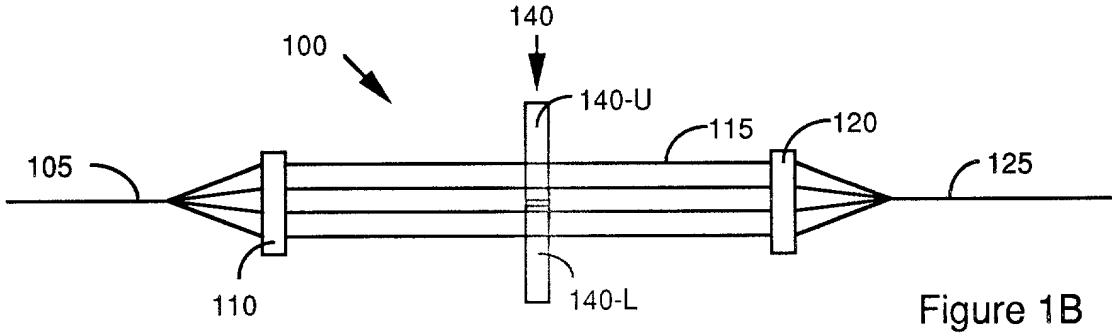


Figure 1B

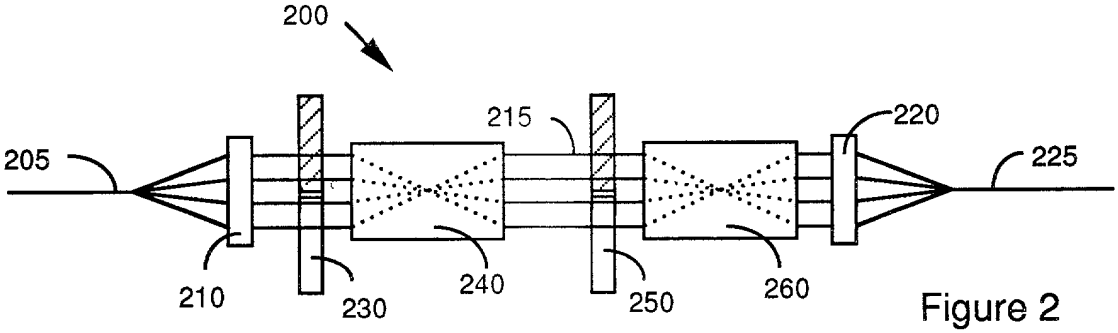


Figure 2

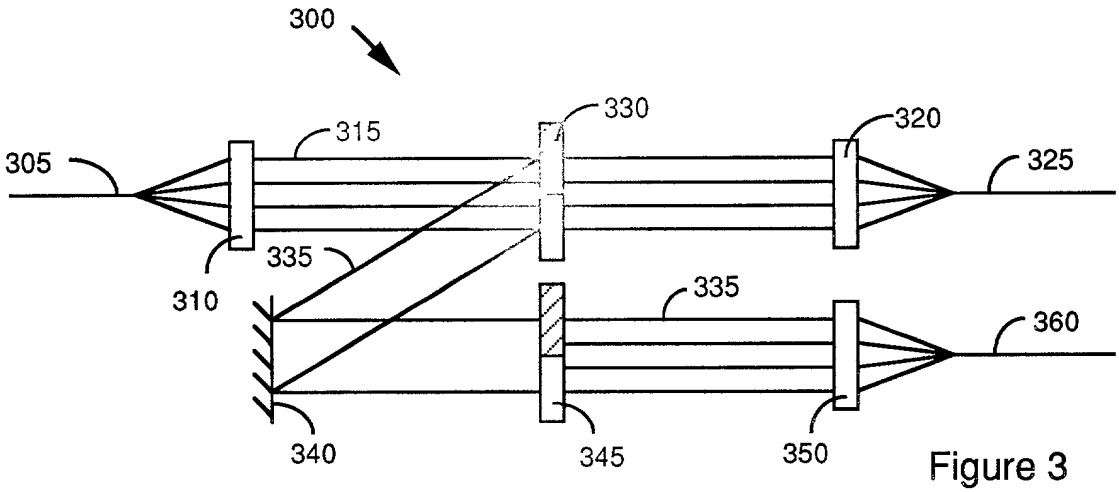


Figure 3

Docket No.OPLINK2k11

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

WAVELENGTH INTERLEAVER

the specification of which (check one)
_X_ is attached hereto.
__ was filed on_____ as Application Serial No._____ and was amended on _____

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s) Priority Claimed

			__ Yes	__ No
(Number)	(Country)	(Day/Month/Year Filed)		

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

60/162,751	November, 1, 1999	Pending
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

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Docket No.OPLINK2k11

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

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